



## 1 Recommendations for Healthful Lighting and Non-Visual Effects of Light

### 1.1 Description of research

Although light is defined as electromagnetic radiation that provides the stimulus for vision, we now know conclusively that photodetection also has many other essential physiological and psychological effects in humans and other organisms. Fundamental photobiology research adds to this knowledge base daily. However, targeted research, performed in concert with applied lighting scientists, will be required to put this knowledge to use as part of integrated lighting recommendations and designs.

### 1.2 Key research questions

In May 2016, CIE published a detailed research agenda for this topic ([CIE 218:2016](#)). Selected examples are given here:

- What pattern of daily light and dark exposure (intensity, spectrum, timing, duration) best supports well-being, both for circadian regulation and acute effects during waking hours (e.g. alertness, emotion, social behaviour)? How does this vary throughout life, from infancy to old age?
- In addition to circadian regulation, what physiological and psychological processes are influenced by ocular light detection?
- There are known medical uses of light to treat certain skin disorders and hyperbilirubinemia. There is speculation that inadequate light exposure during childhood contributes to the development of myopia. These ideas lead to the general question: Are there behavioural or physiological effects of extra-ocular absorption of optical radiation that should influence lighting recommendations?

### 1.3 Justification of the need for the proposed research topic

- The advances in photobiology and psychology offer the potential to use light exposure both for medical treatment (e.g. phototherapy for mood disorders) and to improve well-being in healthy people. This has excited many people, witness the series of existing CIE publications and current activities on this topic.
- Advances in lighting and controls technologies offer unprecedented opportunities to save energy along with opportunities to enhance health and well-being. A comprehensive research effort will direct the development of these new technologies to the benefit of all.
- Manufacturers are promoting “human centric lighting” at times without a firm scientific basis. As a minimum this means that consumers could be wasting money on ineffective lighting solutions. It might also mean that the lighting could result in adverse effects on health and well-being. Improved knowledge is needed to protect the public and to reduce liability issues for commercial suppliers.
- In parallel, environmental considerations lead to pressure to reduce interior light levels, whether provided by daylight and or electric lighting systems, in order to reduce energy use for both lighting and space conditioning (heating and cooling). This appears to be in opposition to the current knowledge, which suggests that most people receive too little optical radiation each day. Knowledge of dose-response relationships – which themselves demand metrics and devices capable of measuring dose accurately – is needed to resolve this conflict.
- A small number of people experience a range of health conditions due to the spectral emission of light sources or due to the temporal characteristics of light received at the eye. Apart from photo-induced epilepsy, little is known about the triggers for these health conditions. It is important that consideration is given to these issues to ensure that some sectors of the community are not unnecessarily excluded from artificially-lit environments.

#### 1.4 Related current activities in CIE

<a href="#">JTC 4 (D3/D6)</a>	<a href="#">Visual, Health, and Environmental Benefits of Windows in Buildings during Daylight Hours</a>
<a href="#">JTC 9 (D1/D2/D3/D6)</a>	<a href="#">Quantifying ocular radiation input for non-visual photoreceptor stimulation</a>

#### 1.5 Existing CIE publications

<a href="#">CIE 139:2001</a>	<a href="#">The Influence of Daylight and Artificial Light on Diurnal and Seasonal Variations in Humans - A Bibliography</a>
<a href="#">CIE 158:2004/2009</a>	<a href="#">Ocular Lighting Effects on Human Physiology and Behaviour</a>
<a href="#">CIE 218:2016</a>	<a href="#">Research Roadmap for Healthful Interior Lighting Applications</a>
<a href="#">CIE TN 003:2015</a>	<a href="#">Report on the First International Workshop on Circadian and Neurophysiological Photometry, 2013</a>
<a href="#">CIE x027:2004</a>	<a href="#">Proceedings of the CIE Symposium 2004 on Light and Health: Non-Visual Effects, 30 Sep.–2 Oct. 2004, Vienna, Austria</a>
<a href="#">CIE x031:2006</a>	<a href="#">Proceedings of the 2nd CIE Expert Symposium "Lighting and Health", 7–8 September 2006, Ottawa, Ontario, Canada</a>
June, 2015	<a href="#">CIE statement on non-visual effects of light: Recommending proper light at the proper time</a>